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Eighth Annual Poultry Field Day

Animal Science Department
South Dakota State University

Eighth Annual

POULTRY DAY

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Agricultural Experiment Station
Cooperative Extension Service
South Dakota State University
Brookings

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South Dakota State University
Brookings, South Dakota

Department of Animal Science
Poultry-Meats Section

A.S. Series 76-1

Fatty Liver Hemorrhagic Syndrome in Laying Hens

R. A. Nelson and C. W. Carlson[1]

Fatty liver hemorrhagic syndrome (FLHS), a major cause of mortality among caged laying hens, was second (15%) to lymphoid leukosis in 1975 among those hens submitted to the Animal Disease Research and Diagnostic Laboratory from this research station. The disease is characterized by a 20 to 25% increase in body weight, a 25 to 30% decrease in egg production and an increase in mortality from excessive liver fat and liver hematomas. Two more experiments on this subject have been completed. One used a normal feeding regime and the other used the force-feeding technique described in last year's Poultry Day Report (A.S. Series 75-28).

In the first experiment *ad libitum* feeding of a high energy (10% fat), corn soybean diet was tested for twelve 28-day periods using 308 hens. Biotin and choline alone and combined at twice the NRC recommended levels were supplemented to give four diets. Three commercial strains of pullets that had been grown on 10% protein low density or 12% protein high density diets were used for the experiment. Three replicates of 4 hens each completed the factorial design.

In the second experiment, corn and wheat-soybean diets (14% protein, 2% fat) were tested at three levels of consumption using the force-feeding technique. Attempts were made to feed at 120 and 140% of normal feed consumption for both types of diets. Five replicates (1 hen/rep) for a total of 30 hens were force-fed for 3 weeks.

Several of the production parameters and the liver data are shown in tables 1 and 2 for experiment 1. Hen-day production was considered quite low, averaging about 61%. Choline enhanced egg production over that of the controls, while the strain of birds had little effect. Pullets grown on a 10% protein diet produced more than those grown on 12% protein. Feed consumption was low due primarily to the high energy level of the diet. The largest intake differences occurred between strains although these were not significant. No significant differences were obtained in body weights.

Some definite trends are apparent for total liver lipid. Although previous grower diets had little effect, there were differences between strains, with strain 1 having the highest tendency to accumulate liver fat. Choline and biotin decreased liver lipid, with choline having the most consistent and dramatic effect, reducing liver lipid by 50%.

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[1]Superintendent, Poultry Research Center, and Professor and Leader, Poultry Research and Extension, respectively.

Table 3 includes the production data for experiment 2. The decreased egg production and increased body weight data for the force-fed groups are symptoms often seen with FLHS. Those birds being force-fed were allowed to eat additional feed which accounts for some of the variation from the attempted 120 and 140% intake.

The data in table 3 also show some definite increases in liver values with increases in feed consumption. Dramatic increases in liver weight, liver score and total liver lipid were obtained through force-feeding, with the corn diet having the more severe effects. The hens on both diets showed symptoms that were typical of FLHS.

Table 1. Effects of Diet and Strain on Production Parameters with *Ad Libitum* Feeding (Experiment 1)

	Hen-day production	Hen-day feed consumed	Initial body weight	Final body weight
	%	gm	kg	kg
Control	59[b] [1]	94	1.56	1.86
Control + choline	65[a]	94	1.56	1.90
Control + biotin	56[b]	88	1.48	1.82
Control + choline + biotin	66[a]	92	1.51	1.79
10% protein grower diet	64[a]	92	1.49	1.80
12% protein grower diet	59[b]	92	1.57	1.88
Strain 1	61	96	1.52	1.88
Strain 2	62	92	1.61	1.83
Strain 3	61	88	1.45	1.80

[1] Data with different superscripts differ at the $P<0.05$ level of significance.

Table 2. Effects of *Ad Libitum* Feeding on Total Liver Lipid (gm) (Experiment 1)

	Grower diet	Layer diet: Control	Control + choline	Control + biotin	Control + choline + biotin	Avg.
Strain 1	10%	10.1	12.9	14.0	7.1	11.0
	12%	21.2	7.4	6.2	4.8	9.9
Strain 2	10%	11.1	4.4	9.0	3.7	7.1
	12%	17.5	5.2	10.6	5.3	9.7
Strain 3	10%	10.7	5.9	9.4	6.6	8.2
	12%	9.2	5.6	10.5	3.7	7.3
Average		13.3	6.9	10.0	5.2	

Table 3. Effects of Force Feeding at Two Levels on Egg Production and Liver Parameters (Experiment 2)

	Hen-day production	Hen-day feed consumed	Average weight gain	Average liver weight	Average liver score[1]	Total liver fat
	%	gm	gm	gm		gm
Corn, normal	78.4	84	63	34.5	1.2	3.82
Corn, 120%	74.6	101 (120%)	332	62.3	2.8	18.06
Corn, 140%	74.6	118 (140%)	337	76.2	2.6	22.80
Wheat, normal	86.8	87	83	35.0	1.0	5.59
Wheat, 120%	72.2	103 (118%)	174	41.9	1.4	6.55
Wheat, 140%	72.4	119 (137%)	218	55.5	3.0	12.20

[1] 1 = no hemorrhages; 2 = 1-10 hemorrhages; 3 = 10-25 hemorrhages; 4 = greater than 25 hemorrhages.

South Dakota State University
Brookings, South Dakota

Department of Animal Science
Poultry-Meats Section

A.S. Series 76-2

Feed Restriction Studies With Layers

E. Guenthner and C. W. Carlson[1]

Limiting feed intake frequently is used to reduce the feed cost of producing eggs. Reducing the nutrient intake can be accomplished by limiting the daily feeding period, available feed or by including fiber to reduce the density of the diet. In a previous experiment in which feeders were covered at 3:00 p.m. and uncovered the following morning at 8:00 a.m., feed restriction adversely affected rate of egg production, feed conversion, egg size and the feed cost of producing eggs. The effects were more severe on the low energy-low protein diets.

This year the test was repeated with the same four diet densities, but the feeding period restriction was less severe. The feeders for one-half of the hens were covered at 8:00 a.m. and uncovered at 4:00 p.m. The four diets were formulated with two levels of protein, 13.9 and 16%, and two levels of energy, 2500 and 2900 Cal M.E. per kg. The pullets were housed in cages at 22 weeks of age with 12 hens and 8 replicates per treatment.

Results of the test are shown in table 1. Hen-day egg production increased with each increase of dietary protein and energy, but, overall, feed restriction reduced egg production 3.9 points or 6%. Feed restriction reduced the daily feed intake 4.3 gm or 4%. Feed restriction increased egg size slightly (0.3 gm) but had no effect on internal quality as measured by Haugh units. Restriction reduced performance most on the low protein diets.

With only one exception, feed conversion improved as the levels of protein and energy increased. However, the full-fed hens had slightly better feed conversion. Feed cost increased 0.6 cents per dozen with feed restriction, and on the average the feed cost for the high density diets averaged lower than the feed costs for low density feeds. The low density diets based on oats frequently cost more than the corn diets, due to the relatively high price of oats.

Mortality was high for this 14-month test, about twice that normally expected. The major causes of mortality were leukosis (big liver) and cannibalism. The full-fed hens had higher death losses than those that were restricted.

The final body weight of hens fed the low density diets was approximately 100 gm less than those fed the high density diets, but feed restriction only reduced overall body weight by 70 grams.

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[1]Assistant Professor and Professor and Leader, Poultry Research and Extension, respectively.

Table 1. Effect of Full Feed vs. Restricted Feeding on Laying Hen Performance

Crude protein, %		13.9		16.0		
Energy, ME/kg		2500	2900	2500	2900	Avg.
HDEP, %						
Full feed		62.4	66.1	66.1	69.7	66.1
Restricted		58.8	59.5	63.9	66.7	62.2
	Avg.	60.6	62.8	65.0	68.2	
Feed/day, gm						
Full feed		108.3	113.3	106.6	108.5	109.2
Restricted		102.8	104.9	105.2	106.6	104.9
	Avg.	105.6	109.1	105.9	107.6	
Egg weight, gm						
Full feed		62.8	63.6	61.7	62.3	62.6
Restricted		63.3	63.1	62.6	62.7	62.9
	Avg.	63.1	63.4	62.2	62.5	
Haugh units						
Full feed		80.7	80.8	79.6	80.2	80.3
Restricted		80.7	80.5	80.3	79.2	80.2
	Avg.	80.7	80.7	80.0	79.7	
Kg feed/doz.						
Full feed		2.193	2.197	1.971	1.878	2.060
Restricted		2.202	2.328	2.020	1.967	2.129
	Avg.	2.198	2.263	1.996	1.923	
Feed cost/doz., ¢						
Full feed		20.1	19.5	20.5	19.2	19.8
Restricted		20.1	21.7	19.9	19.9	20.4
	Avg.	20.1	20.6	20.2	19.6	
Feed cost/ton, $						
Ingredient cost		90	93	97	100	
Mortality, %						
Full feed		16.7	20.0	13.4	19.5	17.4
Restricted		10.6	17.8	8.9	20.0	14.3
	Avg.	13.7	18.9	11.2	19.8	
Final body wt., kg						
Full feed		1.80	1.81	1.89	1.93	1.86
Restricted		1.73	1.73	1.82	1.88	1.79
	Avg.	1.77	1.77	1.86	1.91	

South Dakota State University
Brookings, South Dakota

Department of Animal Science
Poultry-Meats Section

A.S. Series 76-3

Strain Effects With Low Protein Layer Diets

A. B. Kashani and C. W. Carlson[1]

Previous studies at the South Dakota Experiment Station showed that average hen-day egg production over fifteen 28-day periods was reduced from 70 to 67% when the protein content of the diet was lowered from 16 to 12%. Furthermore, the combined addition of methionine and lysine depressed production to 61%. Tryptophan appeared to somewhat alleviate the depression effect caused by methionine and lysine, whereas isoleucine did not further improve hen performance.

This year's study was conducted to determine the effects of strain on response to protein levels and amino acid additions. Twelve 26-week-old pullets from each of three strains were randomly assigned to each of five treatments, using corn-soy layer diets containing both 10 and 12% protein. The formulas for the basal diets are shown in table 1. Cumulative additions of 0.15% DL-methionine, 0.20% L-lysine, 0.10% DL-tryptophan, 0.20% DL-isoleucine and 0.20% DL-valine to the 12% protein diet constituted five treatments as shown in table 2. Five other treatments were obtained as shown by cumulatively supplementing the basal 10% protein diet with 0.30% L-lysine, 0.18% DL-methionine, 0.16% DL-tryptophan, 0.25% DL-isoleucine and 0.25% DL-valine. Unsupplemented 10, 12 and 16% protein diets were also fed to the same strains.

The data obtained from the means of eight 28-day periods showed that egg production for all three strains was not significantly affected when dietary protein was lowered from 16 to 12% (table 3). This is in agreement with the results from the previous study. A trend toward imbalance was noted for the single addition of methionine. A positive response was obtained from the addition of all amino acids. From the eighth period the birds on treatments 3 through 6 were fed the unsupplemented 12% protein diet. Table 4 shows that the birds of strain 1 laid significantly fewer eggs than the other two strains during the next five periods.

The overall means for thirteen periods showed that mean egg production for all three strains was significantly reduced (67% to 54%) when dietary protein was lowered from 16 to 10% (table 5). The three strains responded differently to amino acid supplementation. For strain 1 the diets with lysine and methionine added and for strain 2 and 3 the diets with all amino acids added showed an 11 to 16% increase in production. Inclusion of tryptophan for strain 1 and isoleucine for the other two strains appeared to cause an imbalance which was corrected by the valine addition. This was also apparent with the feed consumption data. Addition of all five amino acids to the 12% protein

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[1]Graduate Assistant and Professor and Leader, Poultry Research and Extension, respectively.

diet allowed for hen-day egg production at a level numerically higher than that of the 16% protein diet. The same general trends were observed when the data on feed consumption and feed efficiency were considered. Interior egg quality and mortality were not significantly affected by the dietary treatments.

Further investigations are being conducted to determine the effects of arginine and threonine additions to a 10% protein diet and their interactions with valine and isoleucine.

Table 1. Composition of Diets

	Protein content		
	16%	12%	10%
Corn (ground yellow)	71.0	80.5	85.5
Soybean meal (47% protein)	20.0	9.0	4.0
Alfalfa meal (17% protein)	2.0	3.0	3.0
Dicalcium phosphate	1.5	1.5	1.5
Salt[1]	0.5	0.5	0.5
Limestone	5.0	5.0	5.0
Vitamin mix[2]	0.5	0.5	0.5

[1]Contained in grams per kg of salt mix: sodium chloride, 920; zinc, 10.0; iron, 6.0; manganese, 4.0; copper, 0.8; cobalt, 0.15 and iodine, 0.07.

[2]Contained per kg of vitamin mix: vitamin A, 1,056,000 USP; vitamin D_3, 275,000 USP; vitamin E, 4,400 IU; vitamin B_{12}, 1.76 mg; riboflavin, 1.320 mg; d-calcium pantothenic acid, 1.760 mg; niacin, 8,800 mg; choline chloride, 88,000 mg; vitamin K, 220 mg; folic acid, 220 mg and biotin, 220 mg.

Table 2. Amino Acid Supplementation of 12 and 10% Protein Diets

Treatment	Added amino acids as percent of the diet				
	DL-methionine	L-lysine	DL-tryptophan	DL-isoleucine	DL-valine
1 (16.0% protein)	--	--	--	--	--
2 (12.0% protein)	--	--	--	--	--
3	0.15	--	--	--	--
4	0.15	0.20	--	--	--
5	0.15	0.20	0.10	--	--
6	0.15	0.20	0.10	0.20	--
7	0.15	0.20	0.10	0.20	0.20
8 (10.0% protein)	--	--	--	--	--
9	0.31	--	--	--	--
10	0.31	0.18	--	--	--
11	0.31	0.18	0.16	--	--
12	0.31	0.18	0.16	0.25	--
13	0.31	0.18	0.16	0.25	0.25

Table 3. Effects of Strain on Response to 12% Protein and Amino Acids

Treatment no.	Hen-day egg production, Means of eight periods			
	Strain 1 (%)	Strain 2 (%)	Strain 3 (%)	Means of 3 strains (%)
1	73.6	65.7	80.4	73.2[a]*
2	67.4	70.2	77.2	71.5[a]
3	66.3	68.3	74.2	69.5[a]
4	66.3	77.2	72.1	71.8[a]
5	74.3	73.9	74.3	74.1[a]
6	64.7	76.1	77.1	72.6[a]
7	76.7	68.3	83.8	76.2[a]

*Data followed by like superscripts do not differ at the $P<0.05$ level of significance.

Table 4. Strain Differences on Response to 12% Protein Diet

28-day period no.	Hen-day egg production		
	Strain 1 (%)	Strain 2 (%)	Strain 3 (%)
9	60.5	76.6	73.7
10	50.6	68.1	62.7
11	49.3	64.9	58.2
12	48.4	59.4	57.5
13	53.3	61.0	53.4
Means of 5 periods*	52.4[b]	66.0[a]	61.1[a]

*Data followed by unlike superscripts differ at the $P<0.01$ level of significance.

Table 5. Effects of Strain on Response to 10 and 12% Protein and Amino Acids

Treatment no.	Hen-day egg production			
	Means of thirteen periods			
	Strain 1 (%)	Strain 2 (%)	Strain 3 (%)	Means of 3 strains (%)
1	66.3	75.4	60.5	67.4[cd]*
2	61.4	69.8	65.3	65.5[bcd]
8	51.2	56.2	55.1	54.2[ab]
9	52.8	58.4	64.4	58.5[abc]
10	62.2	60.4	60.8	61.1[abc]
11	49.9	57.8	67.1	58.3[abc]
12	49.4	52.4	55.4	52.4[a]
13	62.9	72.8	70.1	68.6[cd]
7	71.5	80.1	65.3	72.3[d]

*Data followed by unlike superscripts differ at the $P<0.01$ level of significance.

South Dakota State University
Brookings, South Dakota

Department of Veterinary Science

A.S. Series 76-4

Causes of Mortality in Poultry Submitted to the Animal Disease Research and Diagnostic Laboratory, July 1975 - June 1976

Martin E. Bergeland[1]

	Chicken	Turkey	Other
Airsaculitis	3	9	1 - geese
Amyloidosis			2 - geese
Anemia	4		
Aortic rupture		2	
Arizona infection		5	
Ascaris	1		
Ascites	1		
Aspergillosis		2	2 - geese
Blackhead		1	
Bowel impaction		2	
Breast blister	1		
Bumble foot	1		
Bursal disease	1		
Caged layer paralysis	2		
Cannibalism	69	1	1 - pheasant
Carcinoma	7		
Cardiac insufficiency	2		
Chlamydia			1 - pigeon
Coccidiosis	5	6	1 - pheasant
Conjunctivitis	2	1	
Dehydration	1	4	
Dermatitis	2	1	
E. coli infection	3	19	
Emaciation	1	1	2 - duck parakeet
Encephalitis	1		
Encephalomalacia	1		
Enteritis	1	9	
Erysipelas		1	
Fatty liver	50	1	
Fibroma	1		
Fibrosarcoma	1		1 - parakeet
Fowl cholera		3	6 - ducks geese
Fowl typhoid	1		
Gout	12		
Heat prostration	5		
Hemorrhagic disease	4		
Hepatitis	3	1	2 - geese ducks
Hepatoma	1		
Hexamita		1	
Histomoniasis	1	1	

[1] DVM, Professor of Veterinary Science.

	Chicken	Turkey	Other
Hjarre's disease		2	
Infectious sinusitis		6	
Lead toxicosis			1 - geese
Leukemia, myelogenous	1		
Leukosis, complex	54		
Lice			1 - pelican
Malnutrition	1		1 - geese
Marek's disease, general	6		
Marek's disease, neural	8		
Obesity	13		
Omphalitis		2	
Osteomalacia	12	1	
Osteomyelitis - synovitis	3	5	
Otitis externa			1 - geese
Oviduct impaction	13		
Peritonitis	17		
Perosis	2		
Picornavirus		1	
Pneumonia		1	
Pseudomonas infection	1	41	
Rectal prolapse	4		
Reovirus		9	
Rickets	1		
Round Heart Disease		5	
Salmonellosis	4	21	2 - duck 1 - goose 2 - pigeon
Septicemia	2	8	
Spondylitis		3	
Staphylococcosis	8	4	
Starvation	1	3	
Streptococcosis	1		
Synovitis	2		
Tibial rotation		1	
Toxicosis	1	1	
Trauma	13		4 - pheasant
Tuberculosis	12	1	geese
Vitamin A deficiency	2		

South Dakota State University
Brookings, South Dakota

Department of Animal Science
Poultry-Meats Section

A.S. Series 76-5

A Five-Year Summary of Egg Production, Feed Costs and Conversion

Boyd J. Bonzer and Phillip E. Plumart[1]

The last 5 years of accumulative monthly reports from the South Dakota State University Flock Record program are summarized in this study. The average number of flocks per year was 55, 62, 55, 49, and 30, respectively, for 1971 through 1975. This amounted to an average of 50 flocks per year, averaging 8,500 birds.

Three figures were selected from the monthly data: feed cost per ton, pounds of feed per dozen eggs, and feed cost per dozen eggs. These were studied to determine what happened to feed cost over the 5-year period. Also, we wanted to know if there was a pattern to feed cost and feed conversion over the 5-year period as well as during each year.

Feed cost hovered around $70 per ton until November, 1972, when it started up. It broke $100 in May of 1973, peaked at $142 in October of 1974, and then settled around $120 during 1975. The average feed cost per ton was 84% higher in 1974 than in 1971. These data are shown in table 1.

There was an annual pattern to the monthly average pounds of feed per dozen eggs. The 5-year monthly average showed the best conversion during the summer months (Aug. - 3.9 lb/doz) and the poorest conversion during the winter months (Dec. - 4.7 lb/doz). It took 0.8 of a pound or 21% more feed to produce a dozen eggs in December as compared to August. These data are given in table 2.

The annual average feed conversion improved with higher priced feed. During 1971 and 1972 a dozen eggs was produced with 4.3 lb of feed when feed cost $70 per ton. When feed went up to $128 and $121 per ton in 1974 and 1975, the conversion dropped to 4.15 lb per dozen.

As indicated in table 3, the feed cost per dozen did not fluctuate consistently with the feed cost per ton. After June, 1973, it over reacted up and down. The high point in feed cost per dozen was in January, 1975, 3 months after the October, 1974, high price per ton. The annual average feed cost of 25.92 cents per dozen during 1974 was 11 cents or 73% above 1971.

The 5-year monthly average feed cost per dozen showed the highest feed cost during December (23.4 cents per doz) and the lowest feed cost during July (19.3 cents per doz). There was a difference of 4.1 cents per dozen or 21% in feed cost between the high and low months with gradual increments between them.

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[1] Extension Poultryman and Associate Professor, respectively.

In summary, feed prices started an upward movement in November of 1972 and peaked at an all-time high in October of 1974. There was a monthly pattern to monthly feed conversion showing the best conversion during the summer months and poorest conversion in the winter time. Feed cost per dozen followed the same pattern.

Table 1. Feed Cost Per Ton (Dollars)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
1971	70	71	71	71	72	70	72	70	69	67	67	65	70
1972	67	73	67	68	70	71	68	70	71	69	72	77	70
1973	84	88	91	86	107	129	119	124	115	108	106	115	106
1974	118	120	117	111	111	111	118	138	139	142	140	135	128
1975	133	126	116	121	118	124	120	125	126	119	113	112	121
Avg.	95	96	92	91	96	101	100	105	104	101	99	101	

Table 2. Feed Per Dozen Eggs (Pounds)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
1971	4.3	4.3	4.5	4.3	4.1	4.1	4.3	3.9	4.5	4.2	4.4	4.8	4.3
1972	4.7	4.4	4.5	4.2	4.2	4.3	4.0	3.8	4.1	3.9	4.6	4.9	4.3
1973	4.6	4.8	4.4	4.4	4.7	4.1	3.9	4.0	4.2	4.5	4.9	4.4	4.4
1974	4.6	4.7	4.3	4.3	4.1	3.6	3.7	3.9	3.8	4.0	4.2	4.5	4.1
1975	4.7	4.1	4.3	4.4	3.8	3.9	3.7	3.7	3.9	4.2	4.3	4.8	4.1
Avg.	4.5	4.5	4.4	4.3	4.2	4.0	3.9	3.9	4.1	4.2	4.5	4.7	

Table 3. Feed Cost Per Dozen (Cents)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
1971	15.0	15.4	15.8	15.4	14.9	14.4	15.5	13.5	15.4	14.1	14.7	15.5	15.0
1972	15.6	15.9	15.1	14.4	14.8	15.4	13.7	13.4	14.6	13.6	16.4	18.8	15.1
1973	19.2	21.3	19.9	19.1	25.2	26.5	23.0	24.8	24.1	24.4	25.9	25.3	23.3
1974	27.0	28.1	25.3	23.6	23.0	20.0	22.1	26.9	26.5	28.8	29.3	30.4	25.9
1975	31.1	25.6	25.1	26.5	22.6	24.3	22.2	23.3	24.5	25.1	24.3	27.2	25.1
Avg.	21.6	21.3	20.3	19.8	20.1	20.1	19.3	20.4	21.0	21.2	22.1	23.4	

South Dakota State University
Brookings, South Dakota

Department of Animal Science
Poultry-Meats Section

A.S. Series 76-6

A Five-Year Summary of Egg Production Costs and Income of Layer Flocks on the SDSU Flock Record Program

Phillip E. Plumart[1]

Flockowners cooperating in the South Dakota State University Flock Record Program submitted operating and fixed cost figures after their flocks were closed out. These data and their income data are summarized for the 5 years 1971-72 through 1975-76. The data years run from 1 July to 30 June.

The summarized data are presented in table 1. The average flock size has increased slightly from 8,581 to 9,409. Net Pullet Cost shows a 16% increase from $1.53 in 1971 to $1.78 in 1975.

Note that the feed cost increased 88% from 13.68 to 25.70 cents per dozen. Feed accounted for 70% of the total cost of production in 1975 as compared to 56% in 1971-72. Other operating costs including maintenance, utilities, insurance on buildings and equipment and miscellaneous rose from 0.86 to 0.92 cents per dozen. Medication was not listed as a separate cost for most of these flocks.

Total operating costs as a percent of the total cost of producing a dozen eggs, excluding labor and management, increased from 90 to 96% (22.14 cents in 1971 to 34.92 cents in 1975).

Note that the data as shown in table 1 indicate that fixed costs have gone down. This seems to be due to less depreciation now being charged to flocks as the buildings and equipment increase in age. Fixed costs per dozen eggs were cut in half percentagewise. They were reduced from 10% to 4% of the total cost of production over the 5-year period.

The average cost of producing a dozen eggs, excluding labor and management, increased 48.6% from 24.54 cents in 1971-72 to 36.47 cents in 1975-76. The average income per dozen during the same time increased 72% from 24.3 to 41.78 cents. Percentagewise, income was only 99% of the cost of production in 1971, 97.3% in 1972 and then rose to 144% of the cost of production in 1973-74. It was 134% in 1974-75 and 115% in 1975-76. It appears that increased costs of production during this period have been more than offset by increased income.

Return to labor and management varied from a negative 0.63 cents per dozen in 1972-73 to a high of 13.74 cents in 1973-74 and was 5.31 cents in 1975-76.

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[1]Associate Professor and Extension Poultryman.

Table 1. Operating and Fixed Costs for Layer Flocks on the South Dakota State University Flock Record Program, 1971-1976

Factor	1971-72	1972-73	1973-74	1974-75	1975-76
Flock size	8581	9101	9409	8932	9409
OPERATING COSTS	$	$	$	$	$
Initial cost per pullet	1.70	1.67	1.62	1.80	1.96
Insurance and interest/pullet	0.06	0.09	0.07	0.06	0.06
Less salvage value/pullet	0.23	0.34	0.33	0.18	0.23
Net pullet cost	1.53	1.42	1.36	1.68	1.78
	Average cost per dozen	Average cost per dozen	Average cost per dozen	Average cost per dozen	Average cost per dozen
	Cents	Cents	Cents	Cents	Cents
Net pullet cost	7.60	6.53	6.18	7.31	8.30
Feed cost	13.68	14.08	22.25	23.63	25.70
Medication cost	0.03	0.02	0.00	0.04	0.00
Maintenance cost	0.17	0.11	0.24	0.29	0.13
Utilities cost	0.48	0.40	0.46	0.51	0.63
Insurance on bldg. and equip.	0.11	0.11	0.14	0.12	0.12
Miscellaneous costs	0.07	0.02	0.16	0.04	0.04
Total operating costs	22.14	21.26	29.43	31.94	34.92
FIXED COSTS					
Building depreciation	0.61	0.77	0.56	0.41	0.59
Equipment depreciation	0.88	0.82	0.72	0.41	0.40
Interest on investment	0.69	0.65	0.53	0.55	0.48
Taxes	0.23	0.08	0.11	0.10	0.08
Total fixed costs per dozen	2.40	2.32	1.92	1.47	1.55
TOTAL PRODUCTION COSTS (excluding labor and mgmt.)	24.54	23.58	31.35	33.41	36.47
Average income	24.30	22.95	45.09	44.81	41.78
Return to labor and management	-0.24	-0.63	13.74	11.40	5.31

South Dakota State University
Brookings, South Dakota

Department of Animal Science
Poultry-Meats Section

A.S. Series 76-7

Low Protein Grower and Layer Diets and Their Effects on Reproductive Performance

R. A. Nelson and C. W. Carlson[1]

Numerous studies, including several at this station, have shown that the layer type pullet can utilize diets as low as 10% protein during the later growing stages without affecting their subsequent reproductive performance. Frequently, these types of diets are rather bulky and therefore do not work properly in mechanical feeding systems. This year's study involved the use of a 12% protein, 2825 Kcal diet that was supplemented with methionine and/or lysine to the NRC recommended levels. A fourth diet utilized dehulled oats as its major ingredient. Ten percent alfalfa and 2% yellow grease were used in each diet to help eliminate cannibalism and dust problems. Table 1 shows the composition of these diets.

Four replicates of 44, 10-week-old pullets of three commercial strains were housed at the rate of 11 birds per cage (61 x 41 cm) and fed the four grower diets. The pullets had been started on a high energy, 20% protein corn-soybean diet. At 21 weeks of age they were placed in layer cages and data are now being collected on reproductive performance. Included in this report are the reproductive performance data for the hens from last year's grower study (A.S. Series 75-33).

Table 2 shows the data from the cage grower study. No treatment differences occurred in weight gain due to grower diets, but there was a significant difference between strains at the 15-week period. Strain 1 was significantly less efficient although the difference was not large. Methionine additions caused no increase in weight gain, but they did appear to improve feed efficiency somewhat. The dehulled oats diet greatly improved feed efficiency due to its lower fiber content.

Table 3 shows some of the production data for the completed reproductive cycles from last year's cage-reared birds. An attempt was made to restrict feed consumption after four periods of production by covering the feeders for about 8 hours during the day. Although feed consumption was significantly lowered, the desired 8 to 10% restriction in consumption was not obtained. Significant differences in feed consumption occurred between strains, also.

Although it was not significant, the restricted feeding did lower hen-day production somewhat, while strain 2 performed better on all diet regimes. The higher hen-day production for strain 2 was again reflected in improved feed efficiency in producing a dozen eggs. Feed efficiency and egg size were reduced somewhat on the lower protein layer diets, but these differences were quite small.

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[1]Superintendent, Poultry Research Center, and Professor and Leader, Poultry Research and Extension, respectively.

Mortality was high in most groups due primarily to the high incidence of cannibalism and leukosis.

Table 1. Composition of Grower Diets Used in Caged Pullet Experiment

	Treatment	
	1-3[1]	4
Dehulled oats	--	50
Yellow corn	50	34
Oats	30	--
Soybean meal, 48%	4	--
Dehydrated alfalfa, 17%	10	10
Yellow grease	2	2
Dicalcium phosphate	2	2
Limestone	1	1
Salt mix	0.5	0.5
Vitamin mix	0.5	0.5

[1]Treatment 2 = As 1 + 0.13% DL-methionine. Treatment 3 = As 2 + 0.27% L-lysine.

Table 2. Average Growth Performance of Pullets as Influenced by Grower Diet and Strain

	Initial 10-week weight	15-week weight	Final 20-week weight	Overall feed/gain
	kg	kg	kg	
Strain				
1	0.88	1.21[a1]	1.38	9.23[a]
2	0.86	1.18[b]	1.37	8.82[b]
3	0.89	1.22[a]	1.37	8.90[b]
Treatment				
1. Control	0.88	1.21	1.37	9.31[a]
2. As 1 + 0.13% methionine	0.86	1.20	1.37	9.12[a]
3. As 2 + 0.27% lysine	0.87	1.21	1.37	9.13[a]
4. Dehulled oats	0.88	1.21	1.38	8.36[b]

[1]Means with different superscripts were significantly different at the $P<0.05$ level of probability.

Table 3. Average Performance of Laying Hens as Influenced by Grower Diet, Strain and Layer Diet

Treatment	Hen-day production[1]	Feed per hen per day	Feed per dozen eggs	Egg weight	Mortality
	%	gm	kg	gm	%
Grower diet[2]					
10-1950	67.1	106	1.92	62.8	16
12-2900	67.0	106	1.92	62.8	18
Strain					
1	65.0[b4]	104[c]	1.96	62.9	20
2	70.6[a]	108[a]	1.84	62.9	12
3	65.7[b]	106[b]	1.96	62.7	18
Layer diet					
16%	68.6	106[b]	1.91	63.3[a]	16
12%	67.2	108[a]	1.93	62.4[b]	19
16% restricted[3]	67.2	104[c]	1.86	63.2[a]	17
12% restricted[3]	65.3	106[b]	1.96	62.5[b]	16

[1]Fifteen 28-day periods.

[2]10-1950 = 10% protein-1950 Kcal of ME/kg. 12-2900 = 12% protein-2900 Kcal of ME/kg.

[3]Restricted feeding after 40 weeks of age.

[4]Means with unlike superscripts are significantly different at P<0.05.

South Dakota State University
Brookings, South Dakota

Chemistry and Animal Science Departments

A.S. Series 76-8

Calcium Metabolism and Egg Shell Quality in Laying Hens

Chang Won Kang[1], R. A. Nelson[1], C. W. Carlson[1] and O. E. Olson[2]

This experiment was designed to determine whether diet alterations that cause a somewhat reduced rate of lay could influence shell quality and whether certain chemical and biochemical measurements could be related to a decline in shell quality.

A corn-soy layer diet at two protein levels, 12 and 16%, was used. An effort was made to feed both diets at an unrestricted and restricted (80% of restricted) rate. Eight replicates of 8 birds each were used per treatment. Treatments began when the birds were 20 weeks of age and the experiment was concluded after a period of 56 weeks.

Feed consumption, egg production, egg size, Haugh units, shell thickness, and shell breaking strength were determined every 4 weeks during the experiment. At the conclusion of the work, one bird per replicate was killed and tissues were taken for chemical and biochemical analysis. The data are summarized in table 1.

The data have not been subjected to thorough statistical analysis as yet, but they suggest the following observations:

1. The attempted restriction in feed consumption failed, so only the effects of protein level should be observed.

2. Reducing protein level of the diet increased feed intake, appeared to reduce hen-day egg production and egg size, did not affect Haugh units, increased the grams of feed required per gram of egg, and had no effect on shell thickness or shell breaking strength.

3. Except for carbonic anhydrase, the chemical and biochemical measurements on tissues were not affected. In the case of carbonic anhydrase, the apparent lowering of the level of this enzyme by reducing the protein in the feed was not statistically significant because of rather large deviations within treatments.

In addition to the above, a different method involving a pressure increase mechanism for measuring shell breaking strength was tried. The correlation between its values and shell thickness (0.78) was better than that for the dropping ball method (0.45) used in obtaining the above data.

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[1]Graduate Assistant, Superintendent, Poultry Research Center, and Professor and Leader, Poultry Research and Extension, Department of Animal Science, respectively.

[2]Professor, Chemistry Department.

During the course of the experiment, shell thickness decreased at a rate of 0.0015 mm per period and breaking strength decreased at a rate of 0.15 cm per period.

This experiment is now being repeated with improved procedures for feed consumption control. Toward the conclusion of the experiment, individual data on egg production and shell quality will be collected in order to improve the selection of birds for chemical and biochemical studies.

Table 1. Effect of Protein and Restricted Feeding Time on Egg Production and Calcification Parameters

	Treatment 1	Treatment 2	Treatment 3	Treatment 4
	Unrestricted feeding		Restricted feeding[1]	
	16% protein	12% protein	16% protein	12% protein
Feed consumption (gm/hen/day)	103.8	110.2	103.3	107.3
Protein consumption (gm/hen/day)	16.6	13.2	16.5	12.9
Egg weight (gm)	63.6	62.7	65.5	63.0
Hen-day egg production (%)	70.2	67.6	65.5	63.0
Haugh units	78.4	79.4	79.8	79.2
Feed efficiency (gm egg/gm feed)	0.43	0.39	0.41	0.37
Shell thickness (mm)	0.33	0.33	0.34	0.34
Shell breaking strength (cm) (height of falling ball)	12.9	12.9	12.9	13.3
Serum calcium (mg/100 ml)[2]	20.3 ± 3.2	22.2 ± 5.0	22.5 ± 3.2	24.4 ± 4.3
Bone ash (%)[2]	66.0 ± 1.6	64.9 ± 0.9	67.6 ± 3.8	65.1 ± 1.3
Bone phosphorus (% of ash)[2]	17.2 ± 0.2	17.4 ± 0.3	17.2 ± 0.3	17.4 ± 0.2
Bone calcium (% of ash)[2]	38.6 ± 0.6	38.7 ± 0.6	38.5 ± 0.3	38.5 ± 0.2
Calcium binding protein[2]				
Duodenal (units/mg protein)	0.037 ± 0.016	0.047 ± 0.023	0.040 ± 0.005	0.039 ± 0.017
Shell gland (units/mg protein)	0.012 ± 0.002	0.011 ± 0.002	0.011 ± 0.002	0.011 ± 0.002
Carbonic anhydrase in shell glands (units/mg protein)[2]	10.0 ± 5.6	8.6 ± 4.1	10.4 ± 6.0	7.1 ± 2.9

[1] Feeders were covered from 8 a.m. to 4 p.m. each day.
[2] Data are shown with standard deviations.

South Dakota State University
Brookings, South Dakota

Department of Animal Science
Poultry-Meats Section

A.S. Series 76-9

Copper and Nystatin for Growing Turkeys

E. Guenthner and C. W. Carlson[1]

Previous experiments at this station have shown that we can expect a growth response of approximately 500 grams at maturity when extra copper (120 ppm of the diet) is fed to growing turkeys. This response is usually manifested during the later part of the growing period. Liver tissue analyses indicate that this level of dietary copper does not increase the amount of tissue copper. Since the extra copper apparently is not absorbed by the animal, perhaps part of the beneficial response comes from the effect of copper on the feed itself, i.e., by preventing growth of undesirable organisms. However, concern has been voiced that the extra copper in the manure of turkeys thus fed constitutes a pollutant and an environmental hazard. For this reason a fungicidin (Nystatin) was evaluated as a possible alternative for copper.

A total of 600 Large White poults were started and grown to market size in a windowless house containing 12 pens, each 3 x 4.25 meters in size. The four treatments consisted of the control series, control plus Nystatin at 50 gm per ton, copper at 120 ppm, and a combination of these levels of Nystatin and copper. Each treatment was replicated three times with 25 hens and 25 toms in each pen. During the growing period the poults were weighed individually and feed consumption was recorded on a pen basis. The hens were marketed at 16 weeks of age and the toms retained in their respective pens and on their treatments until 24 weeks of age. Five hens and 5 toms from each pen were slaughtered at market time to provide liver and artery samples. The poults were fed a series of low-protein diets, starting with 23% crude protein and stepped down at 4-week intervals to 12% during the final period. All diets were supplemented with methionine and lysine to meet the NRC recommended minimum levels. The energy values of the diets were formulated to 2800 Cal of M.E. per kg throughout the study.

There were no large weight differences due to dietary treatments. At 16 weeks of age, the hens fed the diets with Nystatin and Nystatin plus copper were significantly heavier than those fed the diet with only the copper supplement but were not significantly heavier than the controls. The weights of the controls and those fed the copper diet occurred in the same weight range. At 16 weeks, the toms fed the Nystatin diet were significantly heavier than the controls but not significantly heavier than those fed the copper diet. The weights of the toms fed the diets with copper alone, Nystatin plus copper, and the controls were not significantly different.

At 24 weeks of age, only the toms fed the copper diet were significantly heavier than the controls, although toms on the Nystatin and Nystatin plus copper treatments were included in this weight range. Also, weights of toms

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[1]Assistant Professor and Professor and Leader, Poultry Research and Extension, respectively.

on the Nystatin and Nystatin plus copper treatments occurred in the range of the controls. Again, as in previous tests, the effects of added copper on growth became more pronounced at the end of the growing period.

The feed conversion ratios at both 16 and 24 weeks followed the same trend. Treatments 1 and 3 (control and Nystatin) allowed for slightly wider ratios (poorer efficiency) than treatments 3 and 4 which included added copper.

On a dry basis the copper content of the livers ranged from 13.2 to 15.2 ppm. There were no significant differences among treatments or among sexes. Based on observations in previous tests, seldom does the copper content of turkey liver exceed 20 ppm. Accordingly, these values shown here would all be considered well within the normal range.

In other trials it was found that feeding extra copper reduced the incidence of aortic rupture among toms. Also, there was a tendency to find a higher percentage of elastin in the birds fed extra copper. In this study, a small but significant increase in elastin of the anterior portion of the main systemic arteries was associated with the copper treatments in both sexes. In the posterior portion of the arteries, where the rupture usually occurs, there was a tendency toward higher elastin content. Only one death loss due to aortic rupture was observed in this test and it was found in a control pen.

Based on this test, it appears that the effects of Nystatin and copper on the growth of turkeys are comparable, with perhaps some advantage for feeding copper to toms over the longer growing period.

Table 1. Effects of Copper and Nystatin on the Market Weight, Feed Conversion, Liver Copper and Aortic Elastin of Growing Turkeys

Diet	Hens 16 wk	Toms 16 wk	Toms 24 wk
	kg	kg	kg
Market weights			
1. Control	6.813ab*	9.118b	14.575b
2. Control + Nystatin, 50 gm/T	6.907a	9.319a	14.732ab
3. Control + Nystatin + copper, 120 ppm	6.895a	9.115b	14.654ab
4. Control + copper, 120 ppm	6.751b	9.176ab	14.863a
Average	6.844	9.182	14.703

	Mixed sexes 16 wk	Toms only 24 wk
Units feed/unit gain		
1. Control	2.608	3.073
2. Control + Nystatin	2.608	2.982
3. Control + Nystatin + copper	2.492	2.938
4. Control + copper	2.510	2.915
Average	2.554	2.977

	Hens ppm	Toms ppm
Liver copper, dry basis		
1. Control	13.2	15.2
2. Control + Nystatin	13.8	14.6
3. Control + Nystatin + copper	13.8	14.2
4. Control + copper	13.5	14.2
Average	13.6	14.6

	Hens		Toms	
	Anterior %	Posterior %	Anterior %	Posterior %
Aortic elastin				
1. Control	11.4b*	2.4	12.4b	2.3
2. Control + Nystatin	11.2b	2.5	12.3b	2.1
3. Control + Nystatin + copper	12.0a	2.5	13.5a	2.7
4. Control + copper	12.6a	2.9	13.7a	2.6
Average	11.8	2.6	13.0	2.4

*Values within one column and parameter having the same superscript do not differ significantly (P>.01).

South Dakota State University
Brookings, South Dakota

Department of Animal Science
Poultry-Meats Section

A.S. Series 76-10

Probiotics for Broilers and Turkeys

E. Guenthner and C. W. Carlson[1]

Probiotic Broiler Study

The objective of this test was to measure the growth response and feed conversion of broiler chicks when fed graduated levels of Probiotic No. 1 with two levels of dietary protein. This material is reported to be a killed culture of lactobacillis and other organisms suspended in the culture media. The duration of the test was 8 weeks starting with day-old Golden Giant broiler male chicks.

The treatments consisted of 10 levels of the probiotic, 3 levels of a placebo (Culture Medium) and 1 level of Culture Supernate fed with each of two levels of protein. A separate control was used for each protein level.

The higher level of protein was formulated to supply 100% of the National Research Council's recommended amino acid (AA) requirements and the lower level of protein supplied 70% of the AA requirements. The starting diets contained 23% and 16% protein, respectively. After 6 weeks and for the remaining 2 weeks of the test, the protein levels were reduced to 20% and 14%, respectively. Throughout the test the energy value of all diets was maintained at 3200 Cal of M.E. per kg of feed.

The broilers were started and grown in a windowless, gas heated, exhaust ventilated facility in brooder-grower wire cages. Three replicate lots of 20 chicks were placed in the upper decks of the 45 x 61 cm starting cages for each of the 30 treatments, making a total of 1800 male chicks used in the study. After 6 weeks, the number of chicks in each lot was reduced to 16, and 8 of these were transferred to the lower deck, resulting in six observational units per treatment.

Feed consumption and body weights by group were recorded at 2-week intervals.. Samples of dead chicks were submitted to the SDSU Diagnostic Laboratory for necropsy. Chicks from selected treatments were submitted to the SDSU Microbiology Department for microbial population studies, the results to be reported elsewhere. Continuous, 24-hour lighting was used throughout the study.

The results of this study are summarized in table 1. Added increments of the probiotic did not produce a graded growth response pattern. The weights of the control group in both the 100% AA and 70% AA treatments ranked among the heavier birds. Among the 100% AA treatments, birds fed the medium and

[1]Assistant Professor and Professor and Leader, Poultry Research and Extension, respectively.

high levels of placebo and the Culture Supernate also ranked among the heavier birds of the test. Broilers fed the 100% AA diets were significantly heavier than those fed the 70% AA diets (1.925 kg vs 1.759 kg).

Feed conversion ratios of the groups fed the 100% AA diets averaged 1.831, while the conversion ratios for the 70% AA groups averaged 2.068 units of feed per unit of gain. Otherwise, there was no pattern relating feed conversion to dietary levels of the probiotic. The broilers readily ate all of the diets and no unusual dropping or bowel conditions were observed.

No unusual health problems were encountered. Diagnostic reports commonly indicated staphlococcal infections of the hock joints and synovial fluid. Hot weather was experienced during the last 2 weeks of the test causing reduced feed intake and excessive water consumption.

Table 1. Body Weights and Feed Conversion of Broilers Fed Graduated Levels of Probiotic at 8 Weeks of Age

		100% AA		70% AA	
Treatment	Probiotic level	8 week weights	Feed conversion	8 week weights	Feed conversion
	gm/T	kg		kg	
A	18	1.860de[1]	1.900	1.719h	2.033
B	36	1.904bc	1.879	1.763fgh	2.061
C	70	1.893cd	1.753	1.788efg	2.045
D	155	1.977a	1.778	1.703h	2.085
E	284	1.886cd	1.866	1.804ef	2.039
F	567	1.891cd	1.787	1.763fgh	2.053
G	1135	1.982a	1.834	1.798efg	2.035
H	2265	1.929abc	1.826	1.775fgh	2.093
I	4538	1.954abc	1.819	1.732fgh	2.107
J	9077	1.852de	1.905	1.744fgh	2.056
K	Low placebo[2]	1.899bcd	1.832	1.749fgh	2.086
L	Medium placebo	1.982a	1.827	1.725gh	2.110
M	High placebo	1.953abc	1.831	1.763fgh	2.066
N	Supernate[3]	1.971ab	1.833	1.774fgh	2.066
O	Control	1.938abc	1.794	1.789efg	2.086
	Average	1.925	1.831	1.759	2.068

[1] Duncan's Multiple Range (P<.01) Test. Values with the same superscripts are not significantly different.
[2] Culture media only without the culture.
[3] Fluid without the dead organisms.

South Dakota State University
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A.S. Series 76-10

Probiotics for Broilers and Turkeys

E. Guenthner and C. W. Carlson[1]

Probiotic Broiler Study

The objective of this test was to measure the growth response and feed conversion of broiler chicks when fed graduated levels of Probiotic No. 1 with two levels of dietary protein. This material is reported to be a killed culture of lactobacillis and other organisms suspended in the culture media. The duration of the test was 8 weeks starting with day-old Golden Giant broiler male chicks.

The treatments consisted of 10 levels of the probiotic, 3 levels of a placebo (Culture Medium) and 1 level of Culture Supernate fed with each of two levels of protein. A separate control was used for each protein level.

The higher level of protein was formulated to supply 100% of the National Research Council's recommended amino acid (AA) requirements and the lower level of protein supplied 70% of the AA requirements. The starting diets contained 23% and 16% protein, respectively. After 6 weeks and for the remaining 2 weeks of the test, the protein levels were reduced to 20% and 14%, respectively. Throughout the test the energy value of all diets was maintained at 3200 Cal of M.E. per kg of feed.

The broilers were started and grown in a windowless, gas heated, exhaust ventilated facility in brooder-grower wire cages. Three replicate lots of 20 chicks were placed in the upper decks of the 45 x 61 cm starting cages for each of the 30 treatments, making a total of 1800 male chicks used in the study. After 6 weeks, the number of chicks in each lot was reduced to 16, and 8 of these were transferred to the lower deck, resulting in six observational units per treatment.

Feed consumption and body weights by group were recorded at 2-week intervals.. Samples of dead chicks were submitted to the SDSU Diagnostic Laboratory for necropsy. Chicks from selected treatments were submitted to the SDSU Microbiology Department for microbial population studies, the results to be reported elsewhere. Continuous, 24-hour lighting was used throughout the study.

The results of this study are summarized in table 1. Added increments of the probiotic did not produce a graded growth response pattern. The weights of the control group in both the 100% AA and 70% AA treatments ranked among the heavier birds. Among the 100% AA treatments, birds fed the medium and

[1]Assistant Professor and Professor and Leader, Poultry Research and Extension, respectively.

high levels of placebo and the Culture Supernate also ranked among the heavier birds of the test. Broilers fed the 100% AA diets were significantly heavier than those fed the 70% AA diets (1.925 kg vs 1.759 kg).

Feed conversion ratios of the groups fed the 100% AA diets averaged 1.831, while the conversion ratios for the 70% AA groups averaged 2.068 units of feed per unit of gain. Otherwise, there was no pattern relating feed conversion to dietary levels of the probiotic. The broilers readily ate all of the diets and no unusual dropping or bowel conditions were observed.

No unusual health problems were encountered. Diagnostic reports commonly indicated staphlococcal infections of the hock joints and synovial fluid. Hot weather was experienced during the last 2 weeks of the test causing reduced feed intake and excessive water consumption.

Table 1. Body Weights and Feed Conversion of Broilers Fed Graduated Levels of Probiotic at 8 Weeks of Age

Treatment	Probiotic level	100% AA 8 week weights	100% AA Feed conversion	70% AA 8 week weights	70% AA Feed conversion
	gm/T	kg		kg	
A	18	1.860de[1]	1.900	1.719h	2.033
B	36	1.904bc	1.879	1.763fgh	2.061
C	70	1.893cd	1.753	1.788efg	2.045
D	155	1.977a	1.778	1.703h	2.085
E	284	1.886cd	1.866	1.804ef	2.039
F	567	1.891cd	1.787	1.763fgh	2.053
G	1135	1.982a	1.834	1.798efg	2.035
H	2265	1.929abc	1.826	1.775fgh	2.093
I	4538	1.954abc	1.819	1.732fgh	2.107
J	9077	1.852de	1.905	1.744fgh	2.056
K	Low placebo[2]	1.899bcd	1.832	1.749fgh	2.086
L	Medium placebo	1.982a	1.827	1.725gh	2.110
M	High placebo	1.953abc	1.831	1.763fgh	2.066
N	Supernate[3]	1.971ab	1.833	1.774fgh	2.066
O	Control	1.938abc	1.794	1.789efg	2.086
	Average	1.925	1.831	1.759	2.068

[1] Duncan's Multiple Range (P<.01) Test. Values with the same superscripts are not significantly different.
[2] Culture media only without the culture.
[3] Fluid without the dead organisms.

Probiotic and Pellets Turkey Study

The objectives of this test were to measure the effects of probiotics in the feed during the early growth period and pelleting condition of the feed during the finishing period on growth and feed efficiency of two strains of Large White toms.

A total of 660 poults, 330 of each of two strains, were grown in electric starting batteries to 3 weeks of age and then moved to 1.8 x 3 m floor pens using the following dietary regime:

1. Basal (commercial starter, grower, finisher)
2. Basal + Probiotic No. 1 at 156 gm per ton
3. Basal + Probiotic No. 2 at 1135 gm per ton

The pen arrangement permitted four replicates of the three dietary treatments for each of the two strains. At 14 weeks of age the following dietary regime was superimposed on each of the previous dietary groups, all diets being pelleted.

1. Basal + 2% fat + no binder
2. Basal + 0.5% fat + no binder
3. Basal + 0.5% fat + 0.5% bentonite
4. Basal + 0.5% fat + 1% commercial pellet aid

The study was concluded when the birds reached 22 weeks of age. Individual body weights and feed consumption by pens were recorded at 2-week intervals.

Results of the probiotic and pelleting effects are shown in table 2. The mortality shown during the first 14 weeks resulted from an unusual condition preceding the test. The accuracy of sexing had not been satisfactory on previous lots of poults, and it was decided to double check the sex at the hatchery. Although the poults appeared normal on delivery, the effects of double sexing quickly became apparent. High death losses took place during the first 10 days. Reports from the SDSU Diagnostic Laboratory indicate that the poults were not complete starveouts, but that their feed intake was less than normal. All poults contained large yolks, and several had evidence of umbilicus inflamation. The yolk material was coagulated in nearly all of the poults. Cultures of the livers and yolk sacs yielded *E. coli*. The significant degree of yolk sac infection probably explained the mortality. Since the mortality subsided abruptly after 10 days, the surviving poults were used in the test. The final body weights, both at 14 and 22 weeks, would indicate that there had not been any detrimental carryover.

Since there were no significant strain-probiotic or strain-pelleting interactions, only the main treatment effects are shown in the table. The only significant and consistent difference was associated with the body weight of the strains. There were no significant effects associated with the use of probiotics or the pelleting conditions in this study.

Probiotic and Pellets Turkey Study

The objectives of this test were to measure the effects of probiotics in the feed during the early growth period and pelleting condition of the feed during the finishing period on growth and feed efficiency of two strains of Large White toms.

A total of 660 poults, 330 of each of two strains, were grown in electric starting batteries to 3 weeks of age and then moved to 1.8 x 3 m floor pens using the following dietary regime:

1. Basal (commercial starter, grower, finisher)
2. Basal + Probiotic No. 1 at 156 gm per ton
3. Basal + Probiotic No. 2 at 1135 gm per ton

The pen arrangement permitted four replicates of the three dietary treatments for each of the two strains. At 14 weeks of age the following dietary regime was superimposed on each of the previous dietary groups, all diets being pelleted.

1. Basal + 2% fat + no binder
2. Basal + 0.5% fat + no binder
3. Basal + 0.5% fat + 0.5% bentonite
4. Basal + 0.5% fat + 1% commercial pellet aid

The study was concluded when the birds reached 22 weeks of age. Individual body weights and feed consumption by pens were recorded at 2-week intervals.

Results of the probiotic and pelleting effects are shown in table 2. The mortality shown during the first 14 weeks resulted from an unusual condition preceding the test. The accuracy of sexing had not been satisfactory on previous lots of poults, and it was decided to double check the sex at the hatchery. Although the poults appeared normal on delivery, the effects of double sexing quickly became apparent. High death losses took place during the first 10 days. Reports from the SDSU Diagnostic Laboratory indicate that the poults were not complete starveouts, but that their feed intake was less than normal. All poults contained large yolks, and several had evidence of umbilicus inflamation. The yolk material was coagulated in nearly all of the poults. Cultures of the livers and yolk sacs yielded *E. coli*. The significant degree of yolk sac infection probably explained the mortality. Since the mortality subsided abruptly after 10 days, the surviving poults were used in the test. The final body weights, both at 14 and 22 weeks, would indicate that there had not been any detrimental carryover.

Since there were no significant strain-probiotic or strain-pelleting interactions, only the main treatment effects are shown in the table. The only significant and consistent difference was associated with the body weight of the strains. There were no significant effects associated with the use of probiotics or the pelleting conditions in this study.

Table 2. Effects of Probiotics and Pelleting Conditions on Growth and Feed Conversion of Two Strains of Large White Turkey Males

Treatment	Mortality	Weight	Feed conversion
	%	kg	
Probiotics (0-14 weeks)			
Strain 1	29.3	7.567a*	2.232
Strain 2	25.9	8.501b	2.180
Basal	30.4	7.960a	2.201
Probiotic No. 1	33.7	8.095a	2.195
Probiotic No. 2	15.6	8.113a	2.202
Pelleting (15-22 weeks)			
Strain 1	3.9	13.214a	2.890
Strain 2	0.6	14.485b	2.874
2% fat	1.1	13.998a	2.882
0.5% fat	3.3	13.885a	2.823
0.5% fat + 0.5% bentonite	4.4	13.784a	2.886
0.5% fat + 1% commercial pellet aid	0.0	13.772a	2.898

*Duncan's Multiple Range (P<.01) Test. Data with unlike superscripts differ significantly.

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Department of Animal Science
Poultry-Meats Section

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What Are the Costs for Poultry Research?

C. W. Carlson[1]

A previous report (Carlson and Mountney, 1976) summarized the scientist-year (SY) and publication costs for poultry in fiscal year 1974. A similar study has now been conducted with reports available for 1975. Data were compiled from the USDA's Inventory of Agricultural Research, Vol. I and II, for 1975 and research reports enumerated from the USDA Current Research Information System's (CRIS) progress reports (Form 421) for 1975. Expenditures for State Agricultural Experiment Stations (SAES) only were tabulated.

On an SY basis, in thousands of dollars, 81 was spent for poultry research, as compared to 108 for beef cattle, 107 for swine, 97 for dairy and 87 for sheep. Similar data for certain crops show corn 73, grain sorghum 65, rice 75, wheat 64, other small grain 60, cotton 72, soybeans 69 and peanuts 70. A total of 254 SY's were involved in poultry research compared to 348 working with beef cattle, 308 with dairy animals, 151 with swine and 79 with sheep.

Poultry research in SAES in 1975 produced 1724 publications of all types. Based on a total research expenditure of $20,632,568, that amounts to $11,950 per publication. Similar costs for states publishing over 10 reports ranged from $4,040 to $95,380 per publication. Mean costs by region were Northeast $23,116, South $15,198, North Central $9,214 and West $14,139.

These costs are only for yearly expenses--salaries, operation and maintenance--and do not include expenditures for facilities or capital outlays. Research is expensive. However, in relation to economic value of the product produced, the total expenditures for poultry research were only 0.30% of the cash farm receipts. Many industries spend 2 to 5% of their gross on research.

[1]Professor and Leader, Poultry Research and Extension. Compiled while on leave with USDA, Cooperative State Research Service, 1975-76.

WHO'S WHO ON THE PROGRAM

Martin E. Bergeland, DVM--Professor, Veterinary Science Department, South Dakota State University

Wayne L. Berndt--Ph.D., Extension Entomologist, Department of Entomology-Zoology, South Dakota State University

Boyd J. Bonzer--Extension Poultryman, Animal Science Department, South Dakota State University

C. Wendell Carlson--Professor and Leader, Poultry Research and Extension, Animal Science Department, South Dakota State University

Edmund Guenthner--Assistant Professor, Animal Science Department, South Dakota State University

Ali B. Kashani--Graduate Assistant, Animal Science Department, South Dakota State University

Jay Muchow--Student, South Dakota State University, Sioux Falls, South Dakota

Marvin Mueller--President, South Dakota Poultry Improvement Association, and Past Poultryman of the Year, Mueller's Hatchery, Tripp, South Dakota

Richard A. Nelson--Superintendent, Poultry Research Center, Animal Science Department, South Dakota State University

Oscar Nygaard--South Dakota American Egg Board Liaison, Lakeview Hatchery, Clear Lake, South Dakota

Phillip E. Plumart--Associate Professor and Extension Poultryman, Animal Science Department, South Dakota State University

Dean R. Portinga--Ph.D., Upper North Central Director, American Egg Board, Willmar, Minnesota

Cliff Stewart--Market Area Manager, Shaver Poultry Breeding Farms, Ltd., Des Moines, Iowa

Harold J. Tuma--Ph.D., Head, Department of Animal Science, South Dakota State University

Clifford Wieczorek--Past Producer of the Year, Mount Vernon, South Dakota

Eighth Annual
Poultry Day
Thursday, October 28, 1976
Ramada Inn -- Sioux Falls, S. D.

10:00 - 10:30 a.m. Registration
Banquet Tickets Available

10:25 a.m. Technical Session
Dr. C. W. Carlson Presiding

10:30 Fatty Liver Studies in Layers........................Richard A. Nelson
10:45 Feed Restriction Studies With Layers..................Edmund Guenthner
11:00 Strain Effects With Low Protein Layer Diets.............Ali B. Kashani
11:15 Causes of Poultry Mortality.......................Dr. Martin Bergeland
11:30 Five-Year Summary of Feed Costs..........................Boyd J. Bonzer
11:40 Flock Record Summary -- 1976.......................Phillip E. Plumart

12:00 noon
Free Time for Lunch

1:25 p.m. Educational Session
Dr. Harold Tuma Presiding

1:30 The Future of Animal Science Research..................Dr. Harold Tuma
1:40 The National Egg Research and Promotion Order.........Dr. Dean Portinga
2:40 Egg Research and Promotion at the State Level............Oscar Nygaard
3:10 Fly Control in the Poultry House......................Dr. Wayne Berndt

3:40 Coffee Break - Courtesy of SDPIA

4:00 SDPIA Annual Business Meeting...........................Marvin Mueller

6:30 Annual Banquet and Awards Program

Master of Ceremonies...Cliff Stewart
Invocation...Dr. C. W. Carlson
Entertainment
Edison Folk group...............................Miss Linda Lang, Leader
My Impressions of Russia and Their Poultry Industry................Jay Muchow
Producer of the Year Award..................................Clifford Wieczorek
Poultryman of the Year Award....................................Marvin Mueller

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